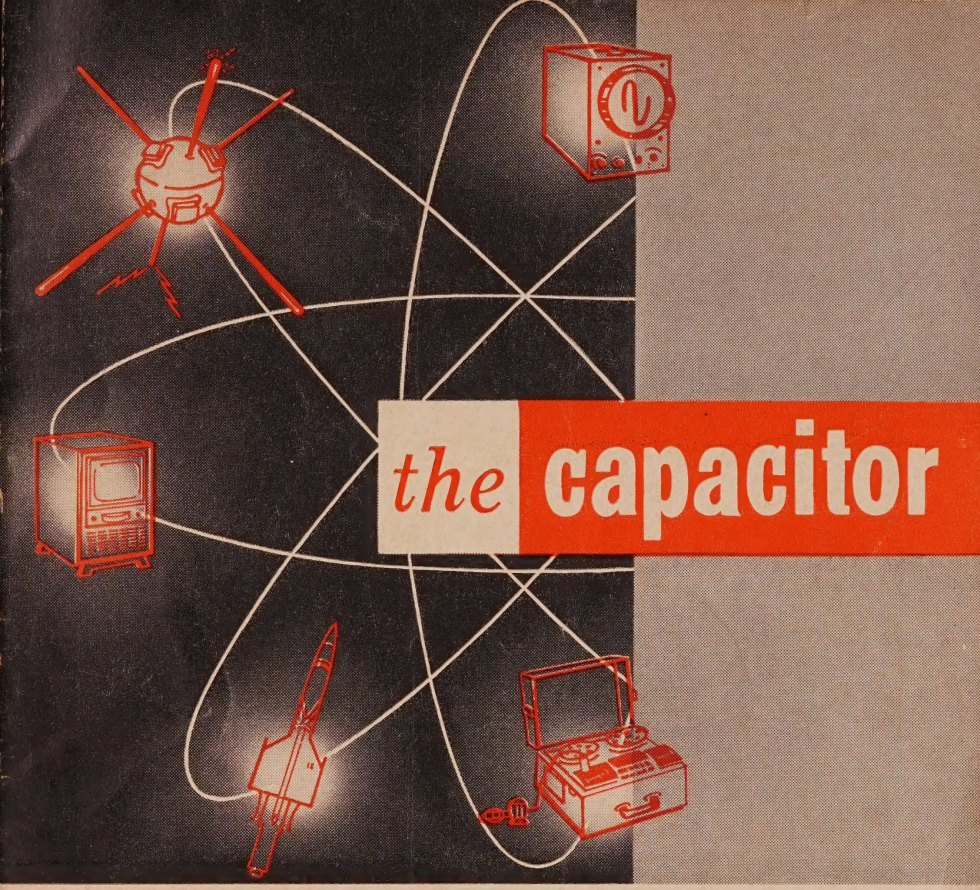

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VOLUME 25 - NO. 3 **MAY - JUNE 1960**

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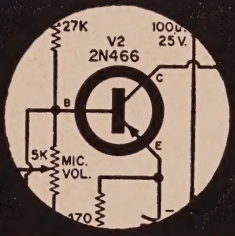

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VOLTAGE - SELECTIVE CIRCUITS

Amplitude-sensitive circuits which can discriminate against predetermined voltages are useful in electronic instrumentation and control systems. In some respects, these circuits are analogous to wave filters. Usually employed for d-c voltage separation, such voltage-selective circuits should be as simple as possible, since they usually will be embodied into other circuitry; and they should be fully electronic in operation, i.e., without electromechanical relays.

Voltage selectivity seems a simple enough matter until the need arises for a circuit to perform a specific task. Then it is realized that the literature on this subject as such is rather sparse. This article describes several voltage-selective circuits which are both simple and practical. All except one (Figure 7) employ passive elements only, thereby furthering simplification and reducing power supply requirements.

For simplicity, bias batteries are shown in several of the circuits. However, where use of a battery is not feasible the d-c bias may be obtained from a transformer-rectifier supply through an appropriate voltage divider having low-resistance output characteristics. In most instances, this power supply will already be a part of the equipment with which the voltage-selective circuit is to be used.

ERRATA

Refer to Parts List for Figure 3 on Page 10 of the NOVEMBER-DECEMBER 1959 Issue of the Capacitor: R_1 should be shown as 7,500 Ohms instead of 0.75 megohm; R_2 should be shown as 22,000 Ohms instead of 0.22 megohm.

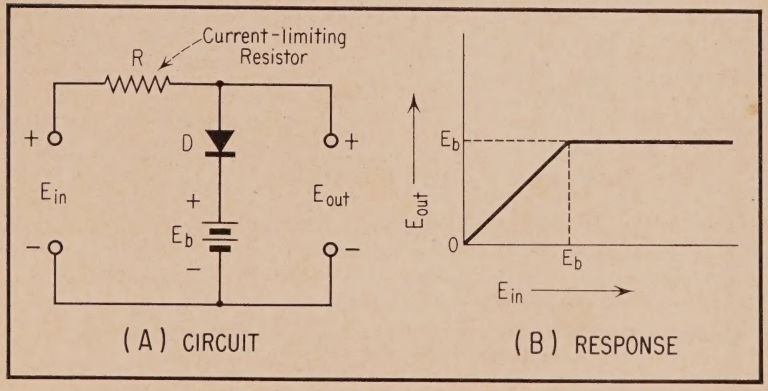

Fig. 1. High-Pass, Output-Limited.

Whereas only representative circuits are shown here, the reader will readily discern that modifications and elaborations are possible and that various ones of the circuits may be cascaded or parallel-connected to obtain selectivity of a sort not shown for the original circuits.

All of the circuits employ diodes. Where the diode is not of the zener type, a conventional silicon unit is recommended for its excellent reverse blocking characteristic. However, germanium and selenium diodes can be used but with somewhat lower effectiveness.

Practical Circuits

Circuit 1. Figure 1(A) shows a circuit whose operation resembles that of a high-pass filter. That is, the output voltage (E_{out}) increases from zero as the input voltage (E_{in}) is increased, but does not reach its maximum level until E_{in} attains a predetermined value. From that point on, E_{out} is constant. Figure 1(B) shows this response.

This circuit is seen to be identical with the well-known diode-type positive-peak limiter. Here, Diode D is connected in series with E_{in}, a current limiting resistor R (usually of the order of 100,000 ohms), and a bias voltage, E_b. Because of the limiting action of this circuit, the output voltage cannot rise above the voltage of E_b, even though E_{in} is increased indefinitely. Voltage E_b may be chosen for the desired operating condition (i.e., maximum output voltage).

If it is desired to operate on a negative input voltage, instead of the positive input shown in Figure 1(A), the battery **and** diode should be reversed.

This circuit may be employed when the requirement is that the output voltage shall not attain a predetermined maximum level until the input voltage has reached a certain level, and that the output voltage shall remain constant from that point on.

Circuit 2. Figure 2(A) shows another type of high-pass circuit. An added feature provided by this circuit is that of delaying the start of the output voltage until the input voltage reaches a predetermined level, E_b. (See Figure 2B.) From this point, the output voltage increases with the input voltage and is not amplitude-limited.

In this circuit, the output voltage, E_{out}, is developed across the load re-

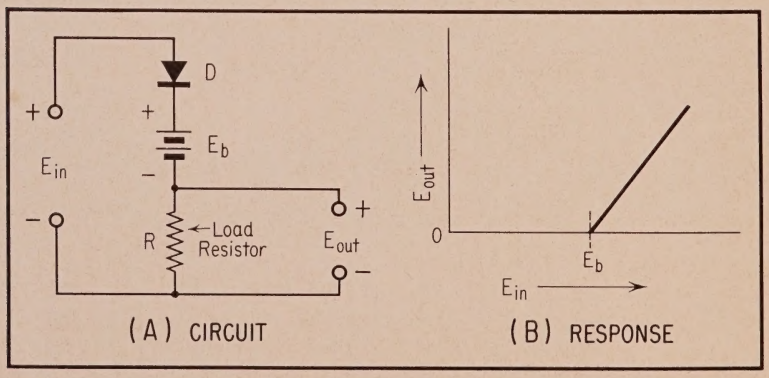

Fig. 2. High-Pass, Delayed-Start, Output-Unlimited.

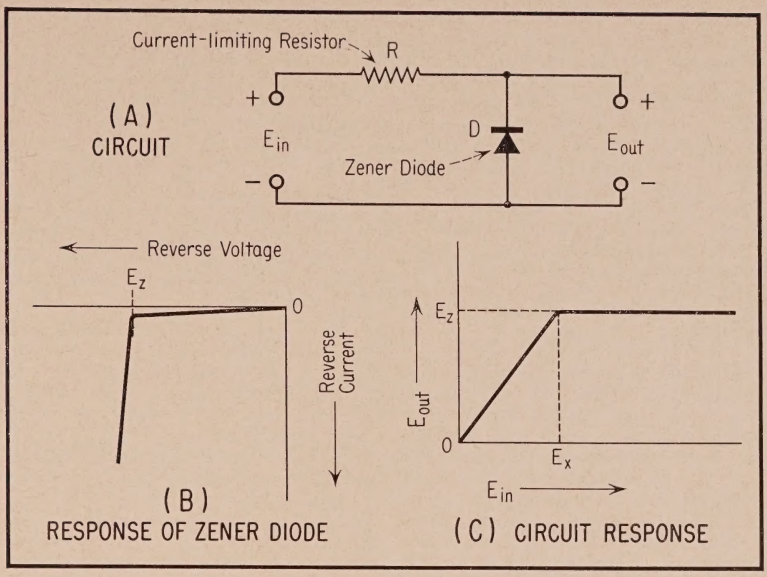

Fig. 3. Zener Equivalent of Fig. 1.

sistor, R. Current cannot flow through this resistor and set up the E_{out} voltage drop, however, until the input voltage, E_{in}, exceeds the bias voltage, E_b. From this point on, current continues to flow through R and the output to increase, as shown beyond the point E_b in Figure 2(B).

The delay is determined by the voltage E_b. This voltage thus acts as a threshold which may be set at a desired level by choice of E_b. This threshold may be made adjustable by providing for variation of E_b. It is evident that if E_{in} is made a function of time, the voltage-delay interval (0 to E_b in Figure 2B) will become a time delay.

This circuit may be employed when the requirement is that the output voltage shall not appear until the input voltage has reached a predetermined level, and that the output shall increase with the input voltage from that point on.

Circuit 3. In some applications, it will be desirable to dispense with the bias voltage sources, E_b in both types of circuit just described. This may be dictated by demands for economy, simplicity, or compactness. Comparable performance may be obtained with zener diodes operated without d-c bias. The price for this simplification, however, is increased loading of the input-voltage source, since the zener diode draws a respectable amount of current.

Figure 3(A) shows a zener diode circuit giving the same sort of performance afforded by the circuit in Figure 1; i.e., high-pass response with output limiting. In this arrangement, the zener diode is reverse-biased by the input voltage.

Figure 3(B) shows the response of the diode alone. As the reverse voltage is increased from zero, only a tiny reverse current flows, because of the

extremely high reverse resistance of the silicon junction. As the reverse voltage is increased, a point (E_z) is reached at which a heavy current suddenly flows for a very small additional increment in voltage. This value E_z is the **zener voltage** (or "zener point") of the diode. Beyond this point, the voltage across the diode is constant although the current increases largely. Zener diodes are supplied in a great variety of E_z values, the diode being selected for this circuit on the basis of $E_z = E_{out}$ (where E_{out} is the desired maximum, constant output voltage).

In Figure 3(A), assuming the output voltage to be applied to a high-resistance load, Diode D has a very high resistance at low reverse current, therefore there is little or no voltage division, due to R and D in series, at low levels of E_{in}. Almost the full value of E_{in} between zero and the zener voltage appears at the output terminals. (See 0 to E_x in Figure 3C.) When E_{in} is such that the zener voltage is applied to the diode, the latter is driven into its high-current region (E_z in Figure 3B) and further increase in E_{in} will not boost E_{out}. This voltage-regulator action stabilizes E_{out} at the level E_z, as shown in Figure 3(C).

Like the circuit given in Figure 1, this circuit may be employed when the requirement is that the output voltage shall not attain a predetermined level (equal to the zener point) until the input voltage has reached a certain level, and that the output voltage shall remain constant from that point on.

Circuit 4. Figure 4(A) shows a zener diode circuit giving the same sort of performance afforded by the circuit in Figure 2; i.e., high-pass response with delayed start, and with the output voltage unlimited.

Here, as in Circuit 3, the diode is reverse-biased by the input voltage. The output voltage is developed as a voltage drop by diode current flowing through the load resistor, R. The resistance of this resistor is chosen low with respect to the zener resistance of the diode. Since the diode is reverse-biased, its resistance will be very high (because of the extreme resistance of the silicon junction) until the zener point is reached. Consequently, at low values of E_{in}, the diode current will be so low that E_{out} will be practically zero. This is represented by the interval between zero and E_z in Figure 4(B). When E_{in} reaches the level E_z, the diode passes heavy zener current which develops a significant voltage

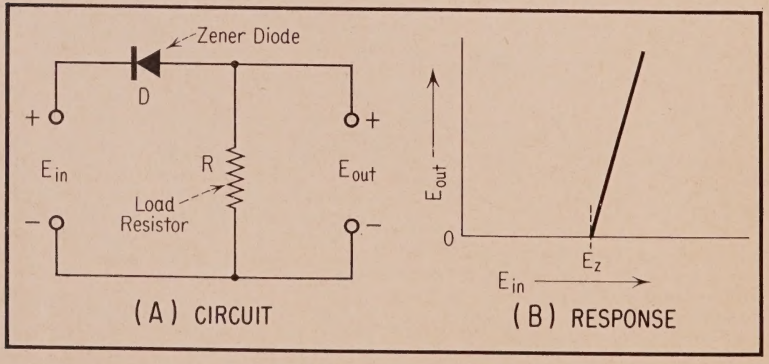

Fig. 4. Zener Equivalent of Fig. 2.

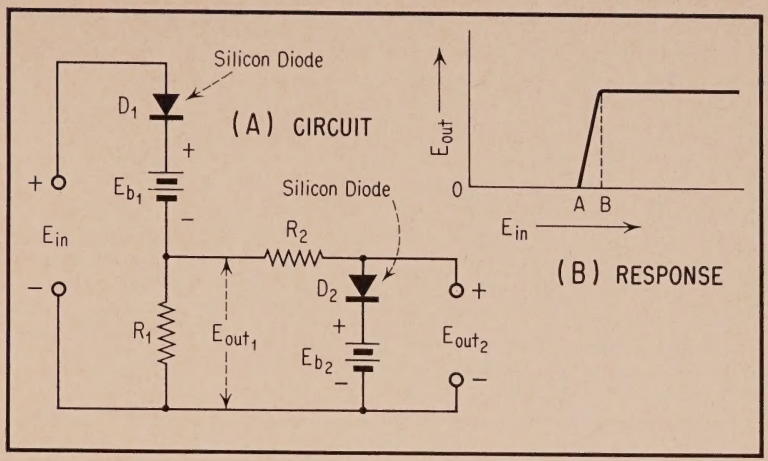

Fig. 5. High-Pass, Delayed-Start, Output-Limited.

across Resistor R. The result is that the output voltage begins to appear and from this point on, will increase with E_{in}.

Like the circuit given in Figure 2, this circuit may be employed when the requirement is that the output voltage shall not appear until the input voltage has reached a predetermined level, and that the output shall increase with the input voltage from that point on. The delay interval (0 to E_z in Figure 4B) is determined by the zener voltage of the diode. The latter is selected to have an E_z rating coinciding with the desired E_{in} starting voltage.

Circuit 5. The circuits shown in Figures 2 and 4 provide delayed start but without output-amplitude limiting. The output voltage is free to increase with the input voltage after the threshold is passed.

When output limiting is desired along with delayed start, the circuit shown in Figure 5(A) may be used. This circuit employs two conventional silicon diodes (D_1 and D_2) and two d-c biases (E_{b1} and E_{b2}). Notice that this circuit (from left to right) is a cascaded combination of the ones shown in Figures 2 and 1, respectively. The D_1 portion of the circuit provides the delay, and the D_2 portion the amplitude limiting. Suitable choice of E_{b1} determines the delay interval, and of E_{b2} the level of the constant output voltage.

The input voltage to the limiter (D_2) is developed as a voltage drop across Resistor R_1; and this voltage is designated E_{out1}, since it is really the output voltage of the delay (D_1) circuit. No current can flow through this resistor (and thus no E_{out1} can be developed) until E_{in} exceeds E_{b1}. As E_{in} is increased beyond this point, E_{out1} increases and also E_{out2}. (The threshold point is labeled A in Figure 5B.) The final output voltage, E_{out2}, cannot exceed the voltage of E_{b2}, however, because of the limiting action of the right half of the circuit, no matter how high E_{in} and E_{out1} become. This leveling-off point is labeled B in Figure 5(B).

This circuit may be employed when the requirement is that the output voltage shall not appear until the input

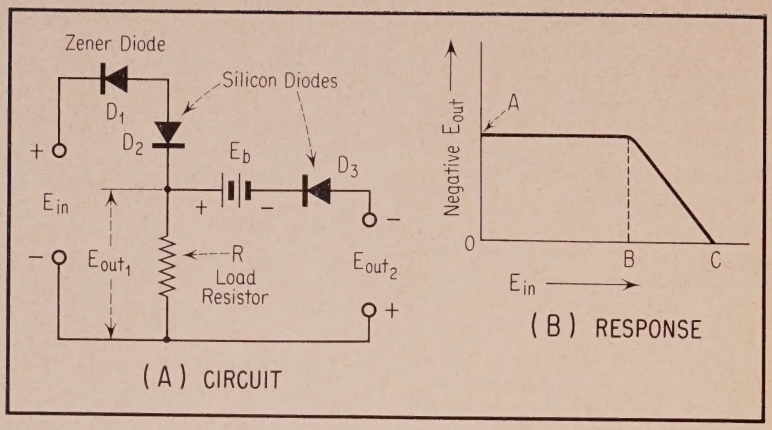

Fig. 6. Low-Pass.

voltage has reached a predetermined level, and that the output shall be amplitude-limited at a predetermined level. Both the delay interval and the limiting level may be made adjustable by providing continuously variable bias voltages, E_{b1} and E_{b2}.

Circuit 6. The circuits described thus far have been of the high-pass type. The circuit shown in Figure 6(A), however, is of the low-pass type. That is, a constant output voltage is delivered until the input voltage reaches a predetermined level, whereupon the output voltage will decrease with increasing input voltage, until at some value of E_{in}, E_{out} becomes zero. This response is shown in Figure 6(B).

In Figure 6(A), the zener diode (D_1) is reverse-biased by the input voltage (E_{in}). The conventional silicon diode (D_2) which is in series with the zener unit is forward-biased by this voltage and accordingly introduces very little resistance. Current flowing in response to E_{in} develops a voltage drop (E_{out1}) across the load resistor (R). At low values of E_{in}, D_1 appears as a very high resistance, and E_{out1} is close to zero, because of voltage divider action between R and the high reverse resistance of D_1.

When E_{in} is zero or very low, there is a voltage (E_{out2}) at the output terminals of the circuit. This voltage is supplied by E_b. The conventional silicon diode, D_3, is forward-biased by E_b and accordingly introduces only a small amount of resistance in the output circuit. This output voltage, E_{out2}, is shown from A to B in Figure 6(B).

When E_{in} reaches the zener point of D_1, a heavy current flows, producing a voltage drop (E_{out1}) across R. This voltage, being of opposite polarity, bucks E_b and reduces E_{out2}. The point at which this bucking action starts is indicated by B in Figure 6(B). As E_{in}

is further increased, E_{out1} increases accordingly and the output voltage of the circuit, E_{out2} is reduced still more. Eventually, when $E_{out1} = E_b$, the bucking action is completed and $E_{out2} =$ zero. (Point C in Figure 6B.) If E_{in} were increased still further, E_{out2} would begin increasing in the opposite direction (i.e., with the upper output terminal positive). To prevent this, Diode D_3 is poled so as to block this opposite voltage. Needed blocking action also is provided by D_2 which is poled to keep E_b from feeding back to the E_{in} terminals.

This circuit may be employed when the requirement is that a predetermined, constant-amplitude output voltage shall be available until the input voltage reaches a predetermined level, whereupon the output voltage shall decrease with input voltage, finally falling to zero. Point B (Figure 6B) is determined by the zener point of Diode D_1; Points A and C by E_b.

Circuit 7. Figure 7(A) shows a circuit which provides bandpass operation. In this arrangement, the input voltage (E_{in}) is employed to shift the frequency of a sharply tuned circuit excited by a stabilized radio-frequency oscillator. This tuning is accomplished by means of a voltage-variable silicon capacitor, C_2, which tunes L_1 to the oscillator frequency.

The silicon capacitor is reverse-biased by the input voltage (E_{in}). Its capacitance varies inversely with applied volt-

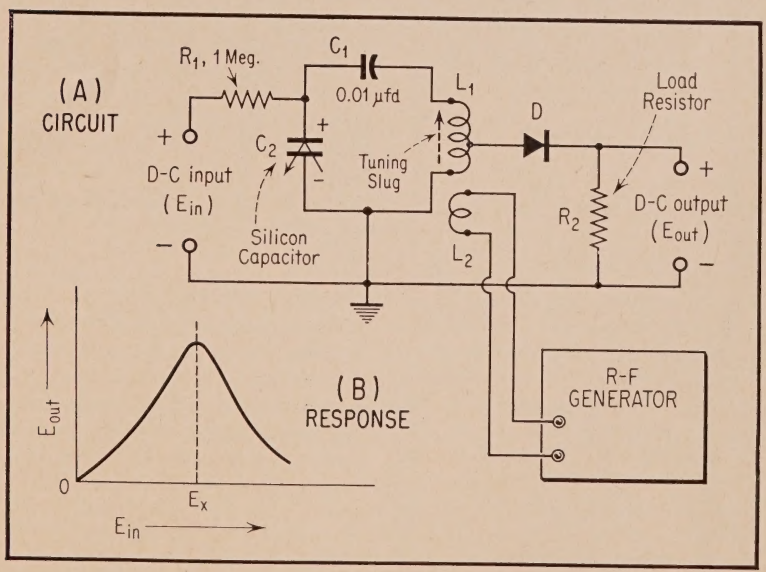

Fig. 7. Band-Pass.

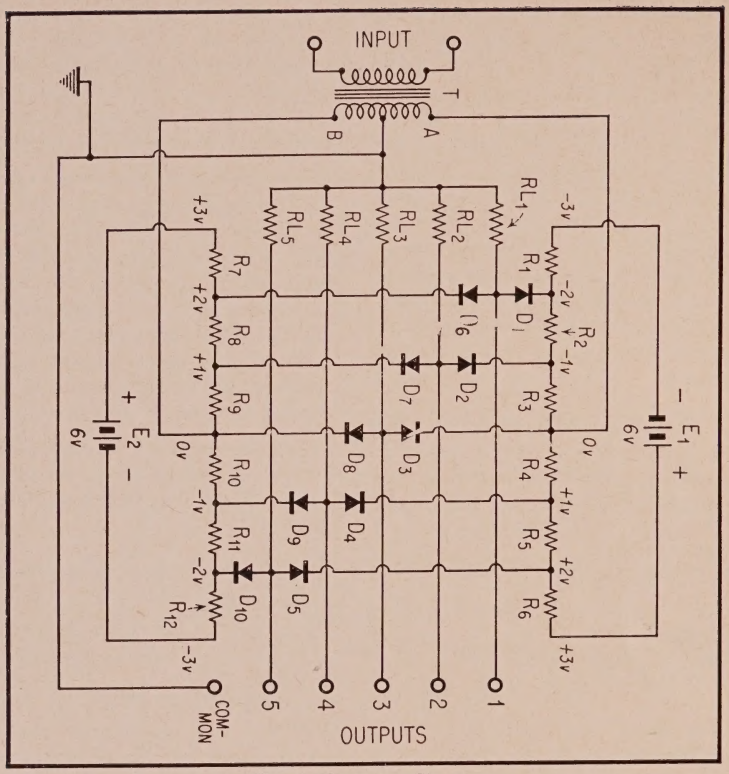

Fig. 8. Quantizer Circuit.

age. The reverse current may be only a few thousandths of a microampere, so this voltage-variable capacitor is essentially voltage-operated. Capacitor C_1 serves a blocking function to keep the dc out of the tank coil, L_1. The 1-megohm resistor, R_1, acts as a radio-frequency choke. Good operation is obtained between 5 and 10 megacycles. The r-f generator is link-coupled to L_1 through the small coil, L_2. Diode D rectifies tank-coil r-f voltage, and its d-c output current develops the output voltage (E_{out}) across Resistor R_2.

With the desired d-c input voltage (E_x in Figure 7B) applied to the input terminals and with the oscillator supplying energy to the tank, Coil L_1 is adjusted to resonance by means of its tuning slug. This results in a peak in E_{out}. (See Point E_x in Figure 7B.) At lower and higher values of E_{in}, E_{out} will decrease, as shown by the response curve. For zero E_{in}, there will be zero

E_{out}. Both frequency and oscillator output amplitude must be stabilized.

This circuit may be employed when the requirement is that an output voltage shall be available for a given, discrete level of input voltage, and that the output voltage shall be as low as possible for all other values of input voltage.

Circuit 8. Figure 8 shows a quantizer-type of voltage-selective circuit invented by George T. Jacobi (U.S. Patent No. 2,612,550).

This is a step-type device. Thus, if the input-signal amplitude is between zero and 1 volt, OUTPUT 1 will be energized; if it is between 1v and 2v, OUTPUT 2 will be energized; etc.

For purposes of illustration, 6-volt d-c bias supplies (E_1 and E_2) are shown. Resistors R_1 to R_6 and R_7 to R_{12}, serve as accurate voltage dividers to supply the indicated positive and negative bias voltages: 0, 1, 2, and 3 v on each side of the circuit. There are five pairs of diodes: D_1–D_6, D_2–D_7, D_3–D_8, D_4–D_9, and D_5–D_{10}. There are also five load resistors: R_{L1}, R_{L2}, R_{L3}, R_{L4}, and R_{L5}. Only one pair of diodes can be nonconducting at one time. (Thus, when no signal is presented to the network by Transformer T, the D_3–D_8 pair is the only nonconducting ones, since no voltage is across them. This results from their being connected between ground — Line 3 — and zero-potential points on the voltage dividers. At this time, all other lines except No. 3 are negative.)

When an input signal is applied through the transformer, one secondary terminal (say, A) is positive, and the other (B) negative. The resulting changed voltage conditions along the voltage dividers then shift the conduction to some other pair of diodes, depending upon the amplitude of the input voltage. Thus, one of the additional outputs, 1, 2, 4, or 5, will be zero. And for any input voltage level, all outputs are negative except one.

Figure 9 shows how the quantizer might be used to actuate a group of tubes associated with an indicator, recorder, or control system. For any given input voltage, all tubes except one will be biased negative by the quantizer outputs and cut off. Only one tube (the one connected to the line carrying the presently-nonconducting diode pair) will be free of blocking bias and able to transmit a signal.

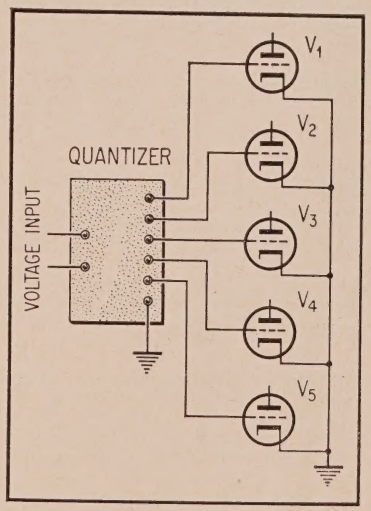

Fig. 9. Application of Quantizer.

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FOR SALE — Fisher 90-T AM-FM tuner and preamp, very good condition, $75; Knight FM tuner kit, assembled, $25. Irving L. Joel, 6701 Boulevard East, West New York, N. J.

WANTED — Instruction manual and schematic (or manufacturer and address) of war surplus signal tracer TS-673/U. Robt. Tanzer, 216 Vine St., Everett, Mass.

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WANTED — Information on Precision 900 tube tester — charts, diagrams, schematics, etc., to modernize to present-day tubes. Will pay nominal fee. John Mennella, 181 N. Corona Ave., Valley Stream, L. I., N. Y.

WANTED — Schematic for McMurdo Silver 906 sig. gen. Borrow, buy or info where it can be obtained. G. Gregory, 6944 Idaho, St. Louis 11, Mo.

WANTED — Main tuning scale, Part No. 83-240 for Hallicrafters S-40-A. Must be in good legible condition, also state price. T. J. Dowler, Box 27, Oceola, Ohio.

SELL — Heathkits, factory calibrated TV align gen., RF gen., bar gen., square wave gen., signal tracer; 3" scope; Seco bias volt supply; Eico flyback tester. $170 for all or separately. A. Draus, 16042 Bell East, Detroit, Mich.

SELL OR TRADE — Seco GCT-5 grid circuit tester; Century fast-checker FC-2 tube tester, like new. Trade for receiver or drafting equip. Robert Fannin, 317 No. Detroit St., Bellefontaine, Ohio.

SELL OR TRADE — Kodabromide printer, Type III, in like new cond., for 3¼" x 4½" prints from 35 mm negatives. Want FM tuner. Al Werhan, Manlius, N. Y.

FOR SALE — Philco G-8000C UHF to UHF and G-8002 generators, both unused, with cables and adapters. Take best offer over $250 for both. Shipping charges collect. Bob's Radio Service, 67 Lafayette St., Plattsburg, N. Y.

SELL OR TRADE — 6 meter Communictor II, 6 volts, very good cond., 8 crystals, crystal microphone, AR22 rotator, 8 El beam, 10 foot mast, all above for $200. Want SX-100, HQ150, RME-4350. Roger Cooper, 7921 Chastain Pl., Reseda, Calif.

FOR SALE — Selling out TV servicing equip., parts, books, and Photofacts, real deal for entire lot. MacArthur, 25363 Victoria Ave., San Bernardino, Calif.

FOR SALE — Model 100 Ortho-Sonic tone arm, GE record compensator, GE preamp., Chicago PSO output trans. J. R. Holloway, 1421 Arch St., Philadelphia 2, Pa.

WANTED — Precision CR-30 picture tube tester; Hickok 770 or 640 oscilloscope. Paul Capito, 637 W. 21 St., Erie, Pa.

FOR SALE — Surplus 20-0-20 ammeters for any 12 volt system. Have 2½" dial face and provision for illumination, $2.49 pp. Martin Goffe, 1011 - 44th St., Brooklyn 19, N. Y. ,

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FOR SALE — DeForest Training, Inc., oscilloscope and signal generator. Best offer. John Hrinda, 1379 Stewart St., Northampton, Pa.

BUY, BEG, BORROW, OR STEAL — Operating manual for Solar capacitor analyzer, type CC-160, made by Solar Mfg. Corp.; also dia. on Elkon trickle charger, type B, made by Elkon Works, Inc., Weehawken, N. J. C. L. Eddy, Box 506, Bellaire, Ohio.

FOR SALE — Heath WA-P2 preamplifier, $14; like new Knight FM tuner, $35, and 18-watt amplifier, $40; Heath W-5M 25 w. amplifier, $55. Trade expensive RCA 3-way portable receiver for Bogen B-50 or similar. Victor Wong, 430 Southview Ave., Cincinnati 19, Ohio.

FOR SALE — SX-28 receiver with matching speaker, $125; BC-221 AH freq. meter, $60; BC-610-E transmitter with BC-614 speech amp. antenna tuning unit and Meissner 9-1090 signal shifter, $350. S. J. Antosy, 341 Bingaman, Reading, Pa.

WANTED — Antique radios. Will pay cash or swap. Need Radiola, Westinghouse, Colin B. Kennedy, Atwater-Kent battery receivers. Chas. Closson, 1290 Glenwood Ave., San Jose 25, Calif.

TRADE OR SELL — Riders Vols. 6, 8, 10, 12 to 15; RCA manuals 1 and 2; Sams radio folios 1 to 41; Motorola FMT50B 50W xmtr with power supply, 117 v. and instr. manual; Jackson condenser tester 650A. Best offer takes any or all. D. Neubauer, 8604 Fayette St., Philadelphia 50, Pa.

WANTED — Precision 856G VOM. Meter should be in working condition. Clifford Lessig, Riegel Ridge, Milford, N. J.

WANTED — Discarded Philco model 640 radio for parts. J. A. Spalla, Plaza, N. Dak.

SELL OR TRADE — Supreme composite vedio generator 665-685-152; about 1200 electron and 6 picture tubes; capacitors and resistors; antenna installation material; numerous parts, test equipment, Sams, Riders, and manufacturer photofact. Earl Silvers, 2501 Union Street, Lafayette, Ind.

WANTED — Job as Radio-TV repairman. National Schools trained. Would work for reasonable wage. Owen Williams, Rt. 2, Box 188, Firebaugh, Calif.

FOR SALE — TV-Radio repair equipment: Precision oscillograph ES-500A, sweep generator E-400, signal generator E-200C, VTVM, as new; instruction manuals, Riders radio manuals, Sams Photofacts. Selling on acc. of health. J. K. Radio Service, 51 No. 17th St., Paterson 2, N. J.

WANTED — REL FM tuner, preferably model 646-B, in good condition. Peter Kemble, Trinity College, Hartford 6, Conn.

FOR SALE — Test equipment, cased, $10 each: Supreme 85 checker and 333 analyzer; Philco 050 checker; Triplett micro ammeter, 5 Rg SW. Also at $25 each: Supreme 504 modernized analyzer; Hickok AC osc. OS8, 8 ranges; RCA 776 AC osc. A. Fiess, 3224 Midland Ave., Syracuse 7, N. Y.

WANTED — One of the following radio receivers for parts: Walgreen T-501 or 522; Spiegel EP2000-1 or DP7001-1; Trav-Ler Karenola T501L, T-530A-L, or T-2625. State condition and price. Charles A. Bland, Jr., 52 West Ave., Wadesboro, N. C.

FOR SALE — National NC-300 receiver, like new cond., $275. Must pick up. Cash only. C. E. Berkheimer, 112 South Sumner St., York, Pa.

FOR SALE — RCA WR-39B TV calibrator crystal controlled from 19 to 240 mc. and RCA WR-59B TV sweep generator, covers 12 TV channels and 1F .3 to 50 mc. Both for $225. James Lawless, 28 Beaufort St., Providence, R. I.

WANTED — Old crystal and early battery sets and horn speakers, any condition. H. M. Kortanek, 4835 So. Keeler Ave., Chicago 23, Ill.

FOR SALE — Presto Professional model "Y" disc recorder and model 87A portable amplifier and PA system as one unit, very high quality. Give best offer. James B. Corum, Upham, N. Dak.

WANTED — HFS receiver; Millen 90810, 90800, 90801, 90281, 90881; Hallicrafter SX73; Hammarlund BC-779; HRO-7 (rack mtd. only); B&W PL20, 024; Gonset 2 m. and 6 m. converters; communicators. Any repairable condition. Lt. W. I. Barry, Civil Air Patrol, Sqd. 1014, Box 333, Upper Darby, Pa.

FOR SALE — Hickok 800 tube tester, orig. carton and factory warranty, $125. Ervin S. Priem, 1104 Seagle Bldg., Gainesville, Fla.

FOR SALE — Riders radio manual No. 12, $3; Delco, Philco, and Bendix auto radio parts, A-1 condition, worth over $300 — $25 for the lot. Darrall Co., 6601 Carnegie Ave., Cleveland 3, Ohio.

WANTED — Repairable tube checkers and VTVMs up to 6 years old, must be reasonable. P. J. Vogel, 3328 Caroline St., St. Louis 4, Mo.

FOR SALE — Sams Photofacts 36 thru 414, $379. James E. Wetz, 824 Alice Street, Monterey, Calif.

SWAP — Like new Heath CRT checker for 35 mm camera, with rangefinder. Vincent Valley, 1312 Frankel Avenue, Metairie, La.

WANTED — Exchange of ideas and circuitry with enthusiasts of pocket size radios and transmitters. Bill Burt, Hares Hill Rd., Kimberton, Pa.

FOR SALE — Cleveland Institute Radio course; BC-474A receiver and xmitter with manual; Link sextant type A-12; ultra-violet light w/fluorescent minerals. H. Kleinfelder, 169 Fingerboard Road, Staten Island 5, N. Y.

WANTED — Wireless and radio equip., books, magazines, etc., 1920 or older. Bob Husted, 105 N. Chester Pike, Glenolden, Pa.

FOR SALE — Linearity pattern generator, Hickok 620, very good cond., recently overhauled by factory. Best offer. Tony Acar, 4017 East 24th Pl., Tulsa 14, Okla.

FOR SALE — Highway Hi-Fi, auto record player, uses 12 v. supply, very good condition with a number of records, can be installed in any make car, $25. Philip R. LiCalzi, Greenwich, N. J.

WANTED — Hallicrafters SR-75 with coils for all bands. Don Guptill, 17 Park St. Ct., Medford, Mass.

FOR SALE — Harvey-Wells all band transmitter, TBS-50D, $65; AC power supply APS-50, $18; RME phone or CW monitor MB-3, $15; Bud 100 kc. xtal calibrator — less xtal, $60. Robert Gossett, 15 Pine Ridge Rd., Weymouth 89, Mass.

FOR SALE — Sams Photofact folders, test equip., can-type electrolytic capacitors, and 2-watt resistors. Retiring from repair business. Livingston Electronics, 9 W. Liberty St., Dansville, N. Y.

WANTED — Instructions and schematic for Supreme 339 deluxe radio analyzer. M. Luttrell, 4 Highland St., R. 2, Bound Brook, N. J.

SWAP — CB transmitter /receiver, 27 mcs. Interested in scope, audio signal gen., RF signal gen., or good offer. T. A. Hughes, 116 Bouchard Ave., Dracut, Mass.

SELL — Used Executone intercom equip. Send for list. Sell highest bidder. Benson, 116 Croftley Rd., Lutherville, Md.

SWAP — CB transceiver for 27 mc.; 10 w. audio amplifier. Swap all or part for communication type receiver, convertor such as RME. H. F. Obrien, 72 Varnum Rd., Dracut, Mass.

TRADE — Over 100 different commemorative stamps, mint condition in plate blocks of 4, about 1945-1948. Need amateur gear, rec., xmtr., etc. What have you? G. Brause, 201 Otsego Ave., San Francisco 12, Calif.

FOR SALE — Heath A7E 7 w. amplifier, $13, EA3 14 w. amplifier, $33, SS1 spkr. system, $43; Bozac B199A and B200X in 6.1 ft. mahogany enclosure, $100; Garrard RC88-4 wf GC7 magnetic diamond stereo cartridge, $55. All for $225. Geo. Sisk, 5212 Warren Dr., Evansville, Ind.

WANTED — Radiola I and Western Elec. 387W studio microphone with housing; other antique battery radios and wireless gear, for cash or swap. Paul Giganti, 2429 San Carlos Ave., San Carlos, Calif.

FOR SALE — Like new 3½" meter, 0-50 ma. scale, round metal case, similar to Weston 301. Ship postpaid for $4.75. L. Cohen, 151-09 34th Ave., Flushing 54, L. I., N. Y.

FOR SALE — 2 Hickok tube testers, 533A Dynamic Mutual Conductance. Bargain for cash. Make offer. Roy Allen, 1706 North Broadway, Oklahoma City, Okla.

SELL OR SWAP — For citizen band transceiver and equipment — Rider TV manuals 4, 5, 12, 15-20; Eico: Deluxe 7" scope, VTVM, capacitor resistor analyzer bridge; Knight in-circuit capacitor tester; 5" TV test CRTs. Control TV-Radio Service, 123 Avenue U, Brooklyn, N. Y.

SELL — SW3 rcvr, $18; 2KVA Variac, $25; QST's 1934 to 1960, make offer; converted BC-696, $5; 6 v. Vibropack, $3; 6 v. Carter 570V dynamotor, $5; 2 mtr. xmtr-converted BC-625 rack mtg., $15. F. M. Hassenplug, 21 So. 29th St., Camp Hill, Pa.

FOR SALE — Meissner 8C FM tuner in very good condition, very reasonable. Al Gasparino, 75 Passaic Ave., Hasbrouck Heights, N. J.

WANTED — Set of coils for Band 1 (200 kc to 500 kc) BC-348 rcvr. Will consider junked BC-348. August Osroff, 3167 Morgan Dr., Wantagh, L. I., N. Y.

FOR SALE — Wallace Aids, half price; Riders X and XI, $5 each; radio and TV books, half price. All F.O.B. T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

FOR SALE — Perfect 16GP4 picture tube, also 12LPM4 picture tube, used 6 mos., fine condition. Raphael Bagley, 738 Oak St., Colusa, Calif.

FOR SALE — Eico 221 VTVM, less probes; Clough-Brengle 3" scope, less probes; IFS Cap-Chek, tubes, parts. Best offer plus shipping. B. Fogelman, 66-01 Almeda Ave., Arverne 92, N. Y.

FOR SALE OR SWAP — Surplus training kits in very good condition; Arkay 5-tube superhet, $7.50; Pic-to-graph wireless oscillator with T-17 mike, $6. Interested in shotgun, binoculars, or 8 mm movie equipment. J. A. d'Hemecourt, 145 E. Henfer, New Orleans 23, La.

FOR SALE — VR transformer — Raytheon, 120 w., 95-130 v. in, 115 v. out, PF 100%, $20 FOB. Raymond Conover, Box 133, Stone Ridge, N. Y.

FOR SALE — DX-40, like new condition, with microphone, $50; ARB Navy receiver, 4 bands, 195 kc., 9 mc., $25. Anthony Schultz, 49-15 Skillman Ave., Woodside 77, N. Y.

FOR SALE — TG-34A keyer, set of 15 Army tapes, J-38 key, phones, and manual. Sol Goldhirsch, 71-11 Austin St., Forest Hills 75, N. Y.

FOR SALE — Fisher Series 80-C Master audio control, has treble, bass-loudness balance, $45 plus shipping charges. Gary Feld, 180 Van Cortlandt Pk., South Bronx 63, N. Y.

SWAP — Florence oil heater, electric radiator, for 3-speed record changer or automatic 45 record changer, or what have you? Thomas F. Elwood, 22 Butler Pl., Rosebank, Staten Island 5, N. Y.

SELL OR TRADE — Zenith console TV, also a complete TV chassis; RCA 45 record changer, $12; Printopress duplicator, $25; Capehart record changer, $9. Want tape recorder or tape deck, musical instruments, electrc organ. Ferd Keller, R. 2, Germantown, N. Y.

FOR SALE — Rider Radio manuals, Vols. 1, 2, 5 to 10 inc., RCA Victor Service Data Vol. 1, nine volumes, $20 plus shipping. Might trade for good binoculars. H. K. Tryon, 7125 Marlborough, Berkeley 5, Calif.

WANTED — Panadapter, buy or swap. Have Atwater-Kent, etc., for trade. State your needs. J. Bobrosky, 16 Dale Ave., Danville, Ill.

WANTED — Elmac 67, must be in good condition and reasonable price. Sell Gonset 75-20-10 convertor, with squelch-limiter unit, $35. Raymond E. Wilton, 4 Liana St., Woburn, Mass.

WANTED — For Cash — 304TL/th tubes and other large plate dissipation types. Ted Dames, 308 Hickory St., Arlington, N. J.

WANT — Tubes including magnetrons, Klystron, and commercial lab equipment including any broadcasting equipment. Leo Diamond, 749 West End Ave., New York 25, N. Y.

TRADE — Almost new EMC model 204 tube tester, for scope or what have you. Bob's Fix-it Shop, Maramec, Okla.

BUSINESS FOR SALE — Car radio shop and home combined, splendid following and plenty of work. I'm tired of working so hard. Town of 60,000. R. K. Roberts, 1371-73 W. Holt, Pomona, Calif.

WANT — Sams, any sets for cash. Sell signal generator. Moser, R. 1, Lewisburg, Pa.

SELL OR TRADE — Halldorson microphone transformer E-1041, $3.75; Kenyon transformer T-104, $3.75; Western Electric output transformer O175913, $1.69. Condition like new. Photocopy reprints: Radio, TV, Hi-Fi Service Data. Send for list. Alexander Podstepny, 1652 Dounton Street, Philadelphia 40, Pa.

WANTED — Automobile radios made before 1935, old automobile manuals, etc. State cond. and price. Martin Stapf, 106E Woodcliff Dr., Columbus 13, Ohio.

FOR SALE — Hickok laboratory type Wattmeter 150 v., 10 amp., $50; Weston 280 DC volt-ammeter, 3 - 15 - 150 v., .15 - 1.5 - 15 amps., $15. Louis M. Mendezoff, 5810 E. Pleasant Valley Rd., Cleveland 31, Ohio.

WANTED — Collins 148C1 FM adapter for 75A3 receiver. Have Sams Photofacts, BC-733 receivers, Collins 8Q2 crystal calibrators from ART13 for swap or sale. J. W. Fantaski, 160 Irwin St., Verona, Pa.

CAN DO — Design, fabrication, electronic, mechanical devices, machining, welding, brazing, soldering, complete or subassemblies, one or many, precision or commercial tolerances. Newton Center Radio Shop, 759 Beacon St., Newton Center 59, Mass.

FOR SALE — Correspondence course from Cleveland Institute, about 2 years old. Best offer accepted. Course in very good shape. R. M. Burleton, Box 235, Oakfield, Wisconsin.

WANTED — Recent Radio and TV Service course, either NRI or RCA. State cond. and price. Albert Kammel, 128 Weisser Ave., Louisville 6, Ky.

SELL OR SWAP — Dumont 208 scope, $35; tape recorder, $35; RBB RBC power supply $12; Weston VOM, $12.50; manuals and schematics for BC779, SCR522, ARN-14, ARN6, ARC34, I-177, BC348, BC312F, FRA, OS-8B/U, etc. Need mobile receiver 80-10 meters. S. Consalvo, 4905 Roanne Dr., Washington 21, D. C.

WANTED — 25 to 40 mc. and 151 to 174 mc. FM receivers with squelch, must be working. G. D. Griffin, 322 West State St., Ithaca, N. Y.

SELL OR TRADE — Late model Viking Valiant xmtr, used about one year, complete with instr. manual and in factory shipping carton. Want Collins 75A2, A3, or A4, also KW Matchbox. S. B. Weidner, 127 So. Main, Ottawa, Kan.

FOR SALE — Never used CX-59A B&W butterfly variable condenser. Will accept any reasonable offer or trade. John Springer, 189 Connellsville St., Uniontown, Pa.

WANTED — Vol. 15 and up Riders TV manuals. State numbers and lowest price. Modern Electric, 111 Main St., Waterville, N. Y.

FOR SALE — Zenith Transoceanic port., very good cond., best cash offer. Jay Chase, 90 Whitney Rd., Short Hills, N. J.

FOR SALE — Galvanometer L & N mirror type in case, fine condition, $20. Regent Radio, 920 W. Erie Ave., Philadelphia 40, Pa.

SELL OR SWAP — Radio, TV and transmitting tubes, radio parts for Sams Photofacts, Rider manuals or what have you. C. W. Brenner, 3818 Waller Road, Tacoma 4, Wash.

FOR SALE — Hickok 277X and 620 generators and 605A tube tester; Precision 201 signal tracer; Blonder-Tongue DA81M distrib. amplifier; Frazier May Maestro speaker; B /J 2¼x3¼ press cameras, f2.9 lens, flash, holders. R. T. Beck, 1305 Jefferson, Racine, Wis.

TRADE — Like new Buesscher Arist. alto saxophone, orig. cost $295, for equal value Sams Photofacts, TV test equip., or what have you. Milton Herpel, Gladwin, Mich.

WANTED — Citizens band transceiver for 27 mc. or 11 meter band Class D. Sell or trade two Vocaline JRC-400 transceivers, complete with aerials, mikes, and cables for 117 v. AC or 6, 12 v. DC, good working order. Will consider good home brew 27 mc. transceiver for 11 meters. John Arnold, Wilson St., Bluffs 3, Ill.

SWAP OR SELL — AM and FM tuner heads, recording heads, 8 mm projectors, 35 mm proj., old plate cameras, 2 to 4 sp. phono., tubes, etc., 25 sets Zim. phones. Want old signal gen., or ?? Cabon, 804 N. Kingsley Dr., Los Angeles 29, Calif.

WANTED — Used or rebuilt front end tuners for RCA model KCS 47AT RF unit KRK8B. Charles F. Green, 524 Almon Ave., Woodbridge, N. J.

FOR SALE — Pair Citizens band transceivers, 5 w., 27.105 mc., Town and Country, $125. Have all instructions, diagrams, and working A-1. Rudolphs Radio and TV, Box 115, Stryker, Ohio.

FOR SALE — Precision E400 sweep gen., E200 sig. gen., and VTVM, $50 each; Heath signal gen., $15, TC2 tube tester with pic tube adaptor, $25; Sprague cond. test, $20. Will ship anywhere PP, insured prepaid. J. J. McManus, 801 Centre St., Ashland, Pa.

WANTED — Grid dip oscillator. Will trade German 3-D camera, or cash. Stanley Wellana, 256 12th Ave., No. Tonawanda, N. Y.

SELL OR TRADE — 11 coil forms Nat'l XR50, $6 p.p. and 6 boxed RCA 6N7 tubes, $10 p.p., or for 3 speed or "45" phonograph. Phonograph details in first letter. Sahr Radio, Fairmont, Minn.

FOR SALE — 386 Photofact manuals, good cond., 75 cents each; 2 steel file cabinets for folders, $15 each; RMS video booster; TEC TV antenna tele-coupler; McMurdo-Silver model 900 VTVM plus RF probe. Tom Serandos, 528 - 28 Ave., Moline, Ill.

WANTED — Minifon P55S or P55L pocket wire recorder. State price, cond., age, and accessories available with it. Alvin Walker, 2202 W. Avalon Dr., Phoenix, Ariz.

FOR SALE — High quality head sets (high resistance wound), xmitter key (new condition). Cheap, no trades. Frank Wooley, 9 Berkley Terr., Irvington, N. J.

FOR SALE — 12 w. speech amplifier, $35; Weston light meter Master 2, $10; Kodak 35 ranger finder extras, $30. F. J. Kern, 50 Shelburne Rd., Springfield, Delaware County, Pa.

WANTED — DB 23 Preselector. W. J. Clark, 711 Post St., San Francisco, Calif.

WANTED — Sams Photofacts. Quote cash price and condition. W. X. Priesmeyer, Box 27, Garwood, Texas.

WANTED — Up-to-date model tube checker. State make, model, age, and best price. D. R. Gladish, 1925 Good Hope, Cape Girardeau, Mo.

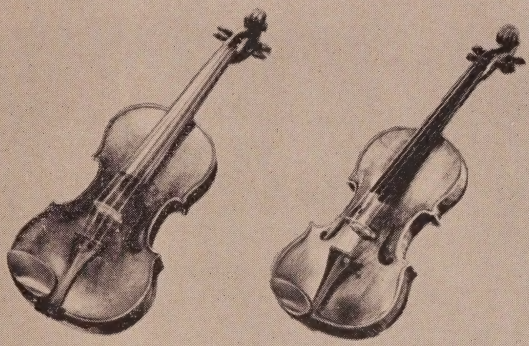
SELL OR TRADE — RCA 7JP4. Want Sams folders or Supreme publications. M. W. Simko, 2337 Manor Ave., Pittsburgh 18, Pa.

FOR SALE — PP-778 ±600v 300 /50 ma Power Supply, new cond., $50, pickup only; 5 Vols. Applied Practical Radio by Coyne $5; 4 vols. Practical Mathematics (Nat. Educ. Alliance) $4, postage. Harry Schwarzlander, 452 Highland Ave., Malden, Mass.

FOR SALE — Hallicrafters HT-32 Transmitter for S.S.B., AM & CW, like new, $475. Myron C. Pogue, 889 Chevy St., Belmont, Calif.

FOR SALE — Eico Capacitor tester; like new. $25 post paid; also Eico Sig. Gen. in fine cond. $45 post paid. L. Bremer, Webster, Wis.

They May Look Alike...



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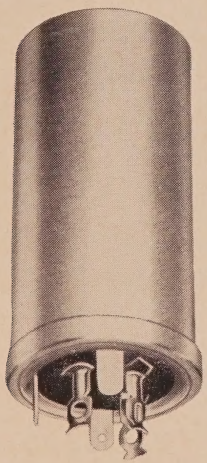

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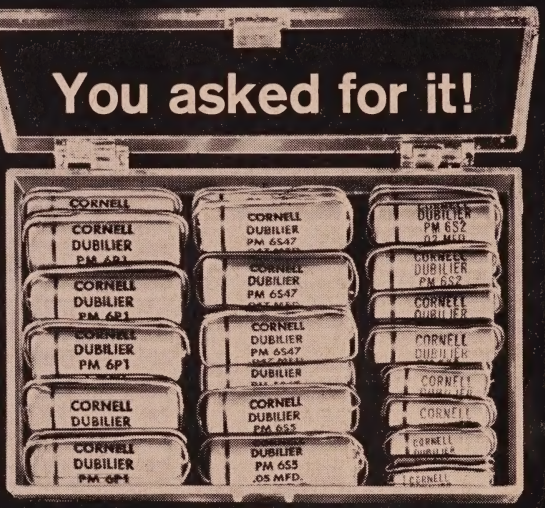

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5	PM 6D5	.005
6	PM 6S1	.01
5	PM 6S2	.02
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6	PM 6S5	.05
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